Rethink Possible

Real Harms & No Benefits

The Commission Should Not Mandate Band 12

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OVERVIEW

Significant Harms, But No Benefits To A Band 12 Interoperability Mandate

The substantial harms of a Band 12 mandate

- Interference from Channel 51
- Interference from the E Block
- AT&T has millions of customers using Band 17 handsets
- Countermanding 3GPP standards would severely undermine future investment in reliance on 3GPP standards

The alleged benefits of a Band 12 mandate are illusory

- Band 12 providers already have access to a variety of cutting edge devices from multiple vendors.
- A Band 12 mandate would not improve access to AT&T LTE/GSM devices

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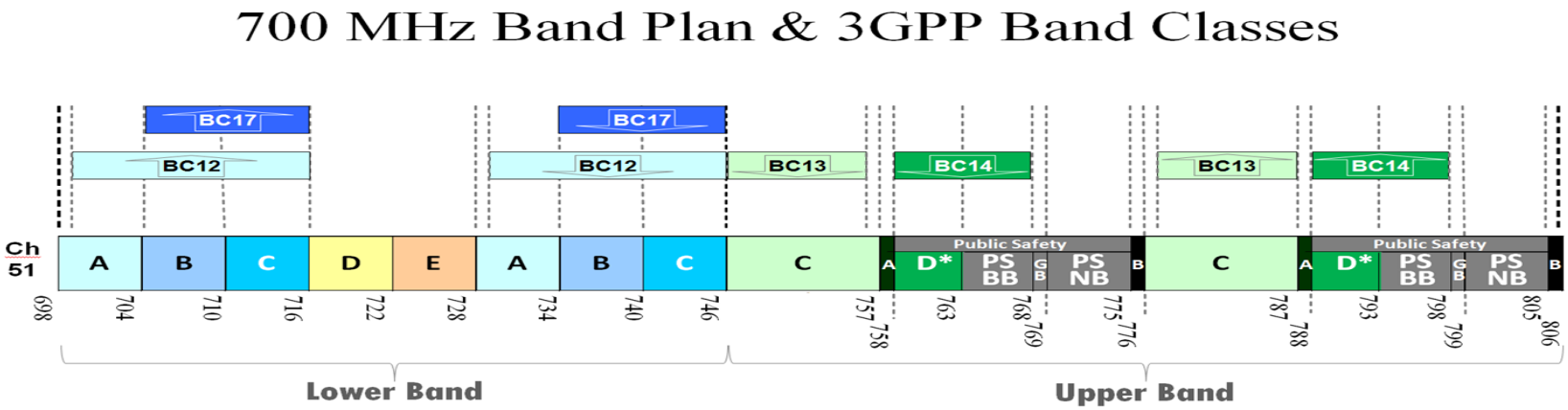
INTERFERENCE: A SERIOUS CONCERN



Channel 51 "Reverse Intermodulation"

Channel 51 signals mix with the User Equipment's ("UE's") transmit signals, creating an "intermodulation product" that falls within the UE's receive frequencies.

Solution = Band 17

(1) provides 6 MHz of separation from Channel 51 and permits the device to much more effectively attenuate Channel 51 signal levels that cause reverse intermodulation

(2) permits the receive frequencies to operate further away from where the intermodulation products fall.

E-Block Interference:

(1) E block signals directly interfere with the UE's receive frequencies

(2) E block signals mix with transmit signals creating intermodulation products that fall within the UE's receive frequencies.

Solution = Band 17

provides 6 MHz of separation from the E block and permits the device to more effectively attenuate interfering E block signals and to avoid the intermodulation product.

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LAB TESTING: CONFIRMING CHANNEL 51 INTERFERENCE

Purpose of Channel 51 Lab Testing

Find the Channel 51 signal levels that cause interference to Band 12 & 17 devices.

Fundamental Lab Testing Principles

1. Test Band 12 and Band 17 devices.
2. Mimic the radio environment where customers commonly use devices and where interference is likely:
   - This means that tests should mimic conditions where LTE signal levels tend to be relatively low and where consumers are likely to use their devices, such as near the cell edge, indoors, and various other locations within the cell that because of environmental or man made obstructions have weak LTE signals.
   - Avoid using higher LTE signals that mimic best case or "average" environments where devices are less prone to interference fails to capture the significant potential for interference.
3. Assign a realistic number of uplink and downlink physical resource blocks (PRBs).
   - Devices tend to be assigned fewer PRBs where multiple people in a cell are attempting to use the network simultaneously.
   - Assigning unrealistically high numbers of PRBs masks the potential for harmful interference under real world conditions.
4. Properly configure test equipment.

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THE VULCAN AND V-COMM CHANNEL 51 TESTS ARE INCONSISTENT WITH FUNDAMENTAL LAB TESTING PRINCIPLES

V-COMM

- Tested conditions where the device would be allocated half of the PRBs on the uplink and all of the PRBs on the downlink, which would occur only where only one or two people were simultaneously using the network.
- Used filters that attenuated interfering signals, which would not happen for real-world Band 12 devices.
- Questions remain as to V-COMM's testing parameters and methodology.

Wireless Strategy

- Did not test Band 12 devices.
- Tried to use Band 17 devices to estimate how a Band 12 device would perform in the presence of Channel 51 signals.
  - Test Report provides no valid technical or other justification for this approach.
  - Test report used formulas for estimating the impact of reverse intermodulation that are not recognized as being accurate measures.
- Unclear what LTE signal levels used.
- Not clear how many PRBs were used.

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PCTEST AND 7LAYERS TESTS ARE FULLY CONSISTENT WITH FUNDAMENTAL LAB TESTING PRINCIPLES

- Tested and compared both Band 12 and Band 17 devices.
- Examined interference for the weaker LTE signals that are common in the real world:
  - reference sensitivity + 3 dB
  - reference sensitivity + 6 dB
- Assigned a realistic, but still a conservatively high, number of PRBs to the uplink and downlink.
  - V-COMM criticized AT&T's tests on grounds that they included RB49 used for PUCCH.
    - But V-COMM's test also included RB49 used for PUCCH
    - Numerous RBs are impacted by interference; inclusion of RB49 has no material impact on the test results.
- Used industry-standard testing equipment

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CHANNEL 51 LAB TEST RESULTS

Band 12 devices begin to experience throughput degradation below 3GPP standards when Channel 51 signal levels reached:

-34 dBm for LTE signal levels at 3 dB above reference sensitivity
-28 dBm for LTE signal levels at 6 dB above reference sensitivity

Everyone agrees that real world channel 51 signal levels are at or above these levels:

- V-COMM, Vulcan, and Qualcomm all find that in large areas around Channel 51 transmitters signal levels will exceed -34 dBm

No performance reduction in Band 17 devices at the tested Channel 51 signal levels.

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CHANNEL 51 INTERFERENCE FIELD TESTING

Channel 51 Field Testing Is Not Yet Practical

- Requires a Band 12 Network deployed in the vicinity of a Channel 51 transmitter. No such networks exist yet.

The Band 12 Network That US Cellular Built For V-COMM

- V-COMM states that it conducted field tests in Waterloo, IA, where U.S. Cellular deployed a Band 12 network operating in the B & C blocks.
- Waterloo is located about 30 miles away from the Channel 51 transmitter, and most of the drive route for the testing was even further away from the transmitter.

Problems With V-COMM's Field Test:

- *Focused Where Interference Is Less Likely:* V-COMM admits that half of its field test measurements occurred in areas where Channel 51 signal levels were below -37 dBm *(i.e.,* below the levels where lab tests show interference is likely to occur). V-COMM does not disclose how many measurements were in areas with Channel 51 signal levels above -30 dBm (its map shows many of these areas).
- *Averaging Masks Interference:* V-COMM reports only "averages" of its field test measurements, making it impossible to determine whether the few measurements it made closer to the Channel 51 transmitter exhibited degraded performance.
- *Unrealistic Scenario:* The U.S. Cellular LTE network was new, and field tests were conducted between 4am and 6am. As a result, the test device was the *only* device in the cell using the Band 12 network (V-COMM confirms this). The network therefore could devote all resources to that single device and overcome interference. In more realistic scenarios, multiple devices will be competing for network resources.
- *Choice of Device/Misleading Results*: V-COMM focused on the Mi-Fi device that was more tolerant of interference, and downplayed the greater interference to the Band 12 smartphone.
- *BLER Meaningless:* LTE networks are designed to achieve a 10% BLER by adjusting modulation schemes, MIMO, retransmissions of packets, and so on in a manner that produces reduced throughput in exchange for the target BLER (i.e., 10%). The fact that V-COMM observed constant BLER says nothing about device performance in terms of throughput.
- *Throughput Meaningless:* Throughput will more than double in an LTE network when spectrum increases from 5 MHz to 10 MHz. It is impossible to determine from V-COMM's comparisons the extent to which throughput increased in the 10 MHz LTE configuration, making it impossible to ascertain how much degradation in throughput was caused by Channel 51 interference.

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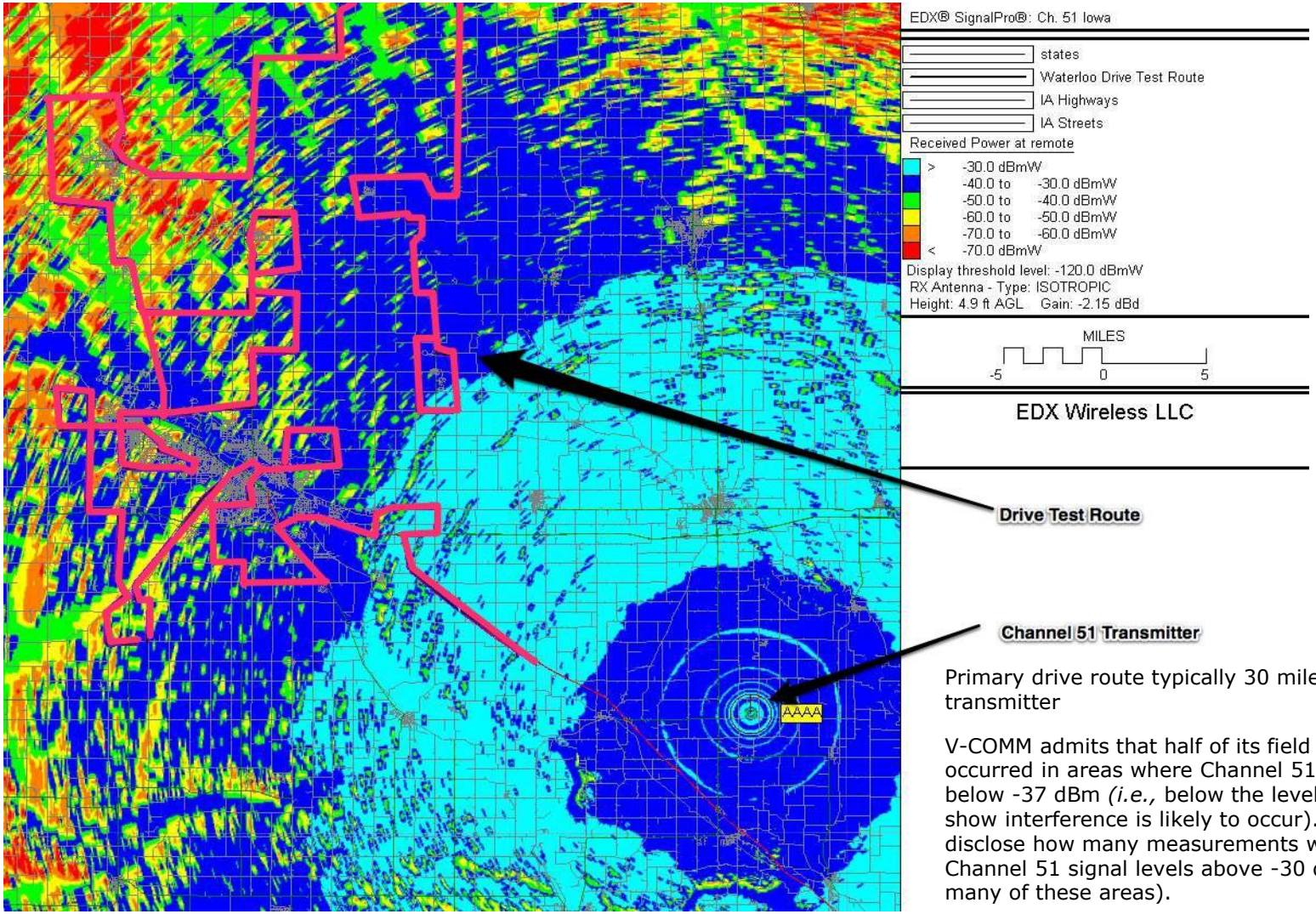
Map Of V-COMM's Field Testing

Most Measurements Taken In Areas With Low Channel 51 Signal Levels



Primary drive route typically 30 miles from Channel 51 transmitter

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E BLOCK INTERFERENCE ANALYSIS

Analysis Of 3GPP Standards & Filter Performance

- Qualcomm showed that under 3GPP standards, LTE devices can withstand E block Interference of -56 dBm at the handset.
  - Band 12 filters offer only 7 dB of E block attenuation, which means that Band 12 devices operating in the B block can withstand E-Block signals up to -49 dBm.
  - Band 17 filters offer 49 dB of E-block rejection which means that Band 17 devices can withstand E block signals as high as -7 dBm.

Conclusion:

- Band 12 devices experience interference when E-Block signal levels reach about -49 dBm, whereas likely real world E-Block signal levels are unlikely to affect Band 17 devices.

Field Tests

- Qualcomm shows field tests from its D block MediaFLO network (with virtually identical propagation characteristics to the E block), and shows that D block levels exceed -49 dBm in large downtown areas.

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E Block Lab & Field Testing Not Viable Today

The Interference Problem

- E block transmission can interfere with Band 12 and Band 17 devices through "blocking" and "intermodulation." Band 12 devices are more susceptible than Band 17 devices to such interference.

No Good Way To Test The Extent Of Potential E Block Interference

- Field Tests Not Possible Because E-Block Networks Are Not Currently Deployed.
- Lab Tests Not Feasible With Today's Equipment.
  - Standard Rhode and Schwartz testing equipment do not include filters and other components that allow lab testing to properly mimic a real E block deployment. The available filters examined by AT&T's testing vendors would have filtered interfering signals that are not filtered in real-world deployments.

V-COMM's E block lab tests are fundamentally flawed:

- LTE signal levels were set at levels that mask interference.
- V-COMM allocated half the of the available PRBs to the uplink and all of the available PRBs to the downlink.
- V-COMM used filter that likely blocked portions of the interfering E block signal.

Vulcan's E block lab tests are fundamentally flawed.

- No Band 12 device
- Did not test for performance degradation, only whether device would operate
- Even Vulcan's flawed tests conclude that E Block signals will cause harmful interference at about -30 dBm, and Vulcan's analysis shows that E block signals at or above -30 dBm are common near E Block transmitters.

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EVEN IGNORING INTERFERENCE, A BAND 12 MANDATE WOULD CAUSE SIGNIFICANT HARM

- Countermanding 3GPP standards would severely undermine future investment in reliance on 3GPP standards.

- AT&T has millions of customers using Band 17 handsets, which would become inoperable if AT&T were to switch to Band 12.

  – Standards that would allow AT&T to support both Band 12 and Band 17 have not yet been released

  – Even if such standards were available, implementing them would require significant cost and testing and cannot be done in the short term.

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THE CLAIM THAT A BAND 12 MANDATE IS NEEDED TO FACILITATE HANDSET AVAILABILITY IS REFUTED BY MARKETPLACE REALITIES

U.S. Cellular's Band 12 Network Is Less Than A Year Old And It Already Offers A Broad Range Of Cutting Edge Devices From Multiple Vendors And Continues To Add New Ones

smartphones/tablets/WIFI hotspots/dongles

. . . And More Are On The Way

"We are currently working with manufacturers to deliver the best 4G LTE capable devices, and we're pleased to introduce our 4G LTE Smartphones, a 4G LTE tablet, a 4G LTE mobile hotspot and a 4G LTE wireless modem." Source: U.S. Cellular Website.

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Nor Would A Band 12 Mandate Increase The Devices Available To Most Band 12 Providers

AT&T Band 12 Devices would **Not** be Compatible with A-Block Carrier Networks

- AT&T Band 12 devices would still fall back to GSM/HSPA technology, not CDMA technology used by most A-Block Carriers.

United Wireless: A Band 12 mandate "makes no difference to people like us. ... If AT&T is forced to go from 17 to 12, they will still have GSM fallback, so that wouldn't open up the availability of handsets to anybody."
(Wireless Week, *LTE Interoperability: The Fix Regional Carriers Count On* (June 1, 2012), http://www.wirelessweek.com/Articles/2012/06/LTE-Interoperability-the-Fix-Regional-Carriers-Count-On)

Nex-Tech: Nex-Tech recently filed a letter asserting that it is having problems obtaining devices compatible with a B block LTE network. Why doesn't Nex-Tech just use AT&T's Band 17 devices? Because Nex-Tech is a legacy CDMA carrier, and it therefore cannot use AT&T's Band 17 devices, which operate only with legacy GSM/HSPA networks.

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BLOCK A LICENSEES ALREADY HAVE A NUMBER OF ROAMING OPTIONS

- **Multi-band LTE chipsets mean that operators have many LTE Roaming options.**
- **AT&T LTE devices have both Band 17 (700 MHz) and Band 4 (AWS) LTE radios. Future AT&T offerings will add Band 2 (Cellular) and Band 5 (PCS) radios.**
- **AT&T, Verizon, Sprint, T-Mobile, Clearwire, Leap, C-Spire, and MetroPCS are all deploying LTE networks, and A Block licensees can choose devices that roam on any of them.**
- **Band 12 providers can also roam on other Band 12 networks.**
- **Options increasing. Qualcomm's chipsets that support up to 3 different bands below 1 GHz and 7 bands in total.**

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